

Laser as a Therapeutic Tool

Lasers have been used safely as a therapeutic tool for over 30 years. Laser Therapy (LT) differs from the use of lasers in surgery due to a lower output power and reduced energy density. Instead of ablating tissue, LT stimulates cellular activity that improves the speed and quality of healing. In over 1,800 publications worldwide, LT has demonstrated its non-invasive, non-toxic quality, and its ability to augment and in some cases, replace, pharmaceuticals and surgical intervention. LT is most often used as a primary medical treatment, but is also effective as a complement to other modalities, such as needle acupuncture and chiropractic adjustment. Acupuncturists, Chiropractors, Physical Therapists, Dentists, Osteopaths and M.D.'s currently use LT for a variety of problems; including the treatment of acute pain and chronic degenerative conditions, improving the speed and quality of wound healing, and for muscle, tendon and ligament injuries.

Laser Therapy as a Healing Stimulus

Lasers commonly in use for LT operate at a wavelength between 600 and 1060 nanometers (nm). Laser devices in this range are known to be safe because they do not include wavelengths in the lower end of the spectrum, which includes X-RAYS and Gamma Rays that cause destructive ionization in the cell. The first lasers used for LT were gas-tube, helium neon lasers at 632nm. Developed in the 1960's, these lasers were very expensive to purchase and too difficult to operate, limiting their availability to just a few well-financed researchers. In the 1980s however, technological advances allowed for the emergence of relatively inexpensive laser diodes with a wide range of wavelengths. Many Therapeutic Lasers were developed and sold during this period, but were all very low power, around 1 milliwatt(mW). The development of devices for LT has proceeded in such small steps because rather than being driven by the demand for LT devices, the production and availability of laser diodes is driven by the massive demand for laser diodes in technology such as compact disc players, laser scanners, and for a wide range of defense applications. As these technologies matured in the 1990's, they were able to handle much higher power outputs, as high as 500mW, resulting in shorter treatment times for LT applications. The availability of more powerful lasers for LT allowed for the treatment of a number of new conditions, and may explain some early clinical studies that showed non-significant results using LT with very low power, sometimes less than 1 milliwatt(mW). Typical power outputs of diode lasers currently available range from 50mW to 500mW.

Wavelengths and Impact of Penetration and Absorption

Portions of these diode laser wavelengths are visible, from 600 up to approximately 780 or 820 nm. Humans have a declining ability to see light above approximately 820nm. Photon energy increases as the wavelength decreases; conversely, penetration through the skin increases as wavelength increases. Thus, certain conditions may benefit from lower wavelengths where most of the energy is absorbed at the surface, and other conditions may benefit more from higher wavelengths that permit deeper penetration. It follows that an ideal wavelength for treating most conditions would be in the midrange.

LT in the Literature

Below we summarize the wide range of effect of LT. A lengthy bibliography can be accessed by downloading or viewing our Laser Bibliography PDF file. More reference can be located by viewing our Links page that connects you to a wide range of sites with even more literature citations.

Cellular: Cellular homeostasis of the mitochondria is modified by laser irradiation, promoting a cascade of events in the respiratory chain of cytochromes, cytochrome oxidase and flavine dehydrogenase that permit absorption of light. The redox status of both mitochondria and cytoplasm are impacted, resulting in improved production of ATP. When cellular membranes are

irradiated, the flow of the membrane ion carriers sodium and potassium are altered, affecting the movement of calcium between cytoplasm and mitochondria. (Karu)¹. Recent study by (Naviaux)² et. al. Demonstrate the affinity of varying mitochondria to varying wavelengths, promoting an enticing model which matches mitochondria of one tissue type with its most effective laser wavelength. (Naviaux) Cell proliferation, motility and secretion are altered when irradiated with laser with specific wavelength, intensity and dose.(Basford)³

Improved micro-circulation after laser irradiation promotes accelerated recovery after injury, resulting from reduced arteriolar and venular vessels and improved blood-flow in nutritional capillaries and activation of angiogenesis. (Zhao⁴, Skobelkin⁵, Kozlov⁶, and Telfer⁷)

Collagen synthesis, proliferation of fibroblasts, faster edema reduction and enhanced lymph flow from LT can accelerate recovery after trauma, through improved edema resolution, regenerated blood and lymph vessels and tendon strength (Lievens⁸).

The improvements induced by laser on collagen production lead to significant increases in collagen content and tensile strength of wounds at one and two weeks following laser treatment (Lyon⁹, Abergel¹⁰). Similarly, (Braverman¹¹) and (Enwemeka¹¹) found improved tensile strength in laser treated wound and tendon groups. Also, Enwemeka found that Laser Therapy not only improved the rate of healing; but led to a better quality of healing. Shoulder tendinitis showed statistical improvement after LT (England¹²).

Beneficial Effect on Nerve Cells and the Production of B-Endorphins

Laser light has a highly beneficial effect on nerve cells which blocks pain transmitted by these cells to the brain. Studies have shown that laser light increases the activity of the ATP-dependent NaK pump. In this case, laser light increases the potential difference across the cell membrane moving the resting potential further from the firing threshold, thus, decreasing nerve ending sensitivity. A less understood pain blocking mechanism involves the product of high levels of painkilling chemicals such as endorphins and enkephalins from the brain, adrenal gland and other areas, as a result of stimulation by laser light. Lombard concluded that the neuropharmacological analgesic effects of lasers are likely due to the release of serotonin acetylcholine at the site and in higher centers. This pharmacological effect leads Baxter to conclude that laser is the premier pain reliever compared to other electro-therapeutic modalities.

How is Laser Therapy Administered?

LT is usually conducted in an outpatient clinic setting, and requires no unusual equipment or precautions except that safety glasses are normally recommended for the patient and therapist. In the United States, the Food and Drug Administration (FDA) requires that laser devices be measured at a distance of 20cm, through a 7mm aperture stop; this measurement is applied to the laser's label. This standard measurement permits the therapist to assess the potential for eye hazard.

The laser is held against the skin in a contact mode (Oshiro), applying the maximum amount of laser light to the area of consideration. Many therapists recommend applying light to firm pressure to the area to distress the underlying blood vessels and tissue to improve the penetration of the energy. The laser is applied at a given power output for a specified period of time, to deliver the proper amount of laser energy, measured in joules. Dosages can range from 1 joule up to 10 or more, depending upon the condition being treated and the schedule of treatments. A wavelength is chosen which meets the absorption requirements of the condition, with wounds and aesthetic conditions benefiting from higher absorption (lower wavelengths), and deep tissue benefiting from deeper penetration (higher wavelengths). Normally, multiple treatments are needed to resolve chronic conditions and injuries. Laser can be directed to acupuncture points, trigger points, nerve endings and directly to the specific injury. Recent findings conclude that, with few exceptions, patients do better when treatment begins as quickly as possible.

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